

## **CLAIMS**

What is claimed is:

- 5        1. A photolithography process with multiple exposures, comprising:
  - providing a wafer having a photoresist formed thereon;
  - providing a photomask aligned above said wafer at a predetermined distance;
- 10        sequentially performing multiple exposures on said photoresist through said photomask, each of said multiple exposures provided with a respective illuminating setting optimized for one duty ratio of said photomask, thereby obtaining an optimum through-pitch performance for pattern transfer onto said photoresist from said photomask; and
- 15        performing a development on said photoresist.
- 20        2. The photolithography process with multiple exposures as claimed in claim 1, wherein said multiple exposures are performed by an exposure tool.
- 25        3. The photolithography process with multiple exposures as claimed in claim 2, wherein said respective illuminating setting comprises illuminating parameters including numerical aperture, sigma value, focus, pupil type and exposure energy of said exposure tool.
- 30        4. The photolithography process with multiple exposures as claimed in claim 1, wherein said multiple exposures are performed with an illuminating wavelength selected from I-line, deep ultraviolet ray, extreme ultraviolet ray, X-ray and ion projection lithography (IPL).
5. The photolithography process with multiple exposures as claimed in claim 2, wherein said multiple exposures are performed with

an illuminating wavelength selected from I-line, deep ultraviolet ray, extreme ultraviolet ray, X-ray and ion projection lithography (IPL).

6. A photolithography process with double exposures,

5 comprising:

providing a wafer having a photoresist formed thereon;

providing a photomask with a dense pattern and an isolated pattern formed therein aligned above said wafer at a predetermined distance;

10 performing a first exposure through said photomask with a first illuminating setting optimized for said dense pattern transfer unto said photoresist from said photomask;

15 performing a second exposure through said photomask with a second illuminating setting optimized for said isolated pattern transfer unto said photoresist from said photomask; and

performing a development on said photoresist.

7. The photolithography process with double exposures as claimed in claim 6, wherein both of said first exposure and said second exposure are performed by an exposure tool.

20 8. The photolithography process with double exposures as claimed in claim 7, wherein said first illuminating setting comprises illuminating parameters including numerical aperture, sigma value, 25 focus, pupil type and exposure energy of said exposure tool.

9. The photolithography process with double exposures as claimed in claim 7, wherein said second illuminating setting comprises illuminating parameters including numerical aperture, sigma value, 30 focus, pupil type and exposure energy of said exposure tool.

10. The photolithography process with double exposures as

claimed in claim 6, wherein said first illuminating setting comprises an off-axis illumination (OAI).

11. The photolithography process with double exposures as  
5 claimed in claim 7, wherein said first illuminating setting comprises an off-axis illumination (OAI).

12. The photolithography process with double exposures as  
claimed in claim 7, wherein said first illuminating setting comprises a  
10 sigma value of said exposure tool not less than 0.85.

13. The photolithography process with double exposures as  
claimed in claim 7, wherein said second illuminating setting comprises a  
sigma value of said exposure tool not more than 0.35.

15 14. The photolithography process with double exposures as  
claimed in claim 7, wherein said first illuminating setting comprises an off-axis illumination (OAI) and said second illumination setting  
comprises a sigma value of said exposure tool not more than 0.35.

20 15. The photolithography process with double exposures as  
claimed in claim 7; wherein said first illuminating setting comprises a  
sigma value of said exposure tool not less than 0.85 and said second  
illumination setting comprises a sigma value of said exposure tool not  
25 more than 0.35.

30 16. The photolithography process with double exposures as  
claimed in claim 6; wherein said first exposure and said second  
exposure are performed with an illuminating wavelength selected from  
I-line, deep ultraviolet ray, extreme ultraviolet ray, X-ray and ion  
projection lithography (IPL).

17. The photolithography process with double exposures as  
claimed in claim 7; wherein said first exposure and said second  
exposure are performed with an illuminating wavelength selected from  
I-line, deep ultraviolet ray, extreme ultraviolet ray, X-ray and ion  
5 projection lithography (IPL).

18. A photolithography process with double exposures,  
comprising:

providing a wafer having a photoresist formed thereon;

10 providing a photomask with an isolated pattern and a dense  
pattern formed therein aligned above said wafer at a predetermined  
distance;

15 performing a first exposure through said photomask with a first  
illuminating setting optimized for said isolated pattern transfer unto  
said photoresist from said photomask;

performing a second exposure through said photomask with a  
second illuminating setting optimized for said dense pattern transfer  
unto said photoresist from said photomask; and

20 performing a development on said photoresist.

19. The photolithography process with double exposures as  
claimed in claim 18, wherein both of said first exposure and said second  
exposure are performed by an exposure tool.

25 20. The photolithography process with double exposures as  
claimed in claim 19, wherein said first illuminating setting comprises  
illuminating parameters including numerical aperture, sigma value,  
focus, pupil type and exposure energy of said exposure tool.

30 21. The photolithography process with double exposures as  
claimed in claim 19, wherein said second illuminating setting comprises  
illuminating parameters including numerical aperture, sigma value,

focus, pupil type and exposure energy of said exposure tool.

22. The photolithography process with double exposures as claimed in claim 18, wherein said second illuminating setting comprises  
5 an off-axis illumination (OAI).

23. The photolithography process with double exposures as claimed in claim 19, wherein said second illuminating setting comprises an off-axis illumination (OAI).

10 24. The photolithography process with double exposures as claimed in claim 19; wherein said second illuminating setting comprises a sigma value of said exposure tool not less than 0.85.

15 25. The photolithography process with double exposures as claimed in claim 19; wherein said first illuminating setting comprises a sigma value of said exposure tool not more than 0.35.

20 26. The photolithography process with double exposures as claimed in claim 19; wherein said first illuminating setting comprises a sigma value of said exposure tool not more than 0.35 and said second illumination setting comprises an off-axis illumination (OAI).

25 27. The photolithography process with double exposures as claimed in claim 19; wherein said first illuminating setting comprises a sigma value of said exposure tool not more than 0.35 and said second illumination setting comprises a sigma value of said exposure tool not less than 0.85.

30 28. The photolithography process with double exposures as claimed in claim 18, wherein said first exposure and said second exposure are performed with an illuminating wavelength selected from

I-line, deep ultraviolet ray, extreme ultraviolet ray, X-ray and ion projection lithography (IPL).

29. The photolithography process with double exposures as  
5 claimed in claim 19, wherein said first exposure and said second exposure are performed with an illuminating wavelength selected from I-line, deep ultraviolet ray, extreme ultraviolet ray, X-ray and ion projection lithography (IPL).